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Impact of inquiry-based working on the capacity to change in primary education

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Abstract

Educational improvement projects are increasingly focused upon the significant role of data in determining student performance, teachers' learning, and schools' ability to initiate local reforms. Thus, schools are moving toward a new approach to learning, progressing from the routine to the non-routine through inquiry-based working. In addition, educational improvement requires teachers to exhibit the capacity to change, namely, to implement the innovations proposed by government agencies or the schools themselves. Therefore, the current study investigates the extent to which the inquiry-based working of primary school teachers predicts their capacity to change. Furthermore, the study identifies which aspects of inquiry-based working are the critical drivers in the capacity to change. A mixed model analysis of questionnaire data collected from a sample of 787 teachers at 65 Dutch elementary schools revealed that the central aspects of inquiry-based work (i.e., working with an inquiry habit of mind, demonstrating data literacy, using data in the classroom, and using data at the school level) are significant in promoting an increased capacity to change. Working with an inquiry habit of mind emerged as the most critical aspect. Data use in the classroom and at the school level are complementary factors that also enhance a teacher's capacity to change.

Keywords Capacity to change · Collaboration · Inquiry-based working · Inquiry habit of mind · Professional learning activities

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Introduction

Schools across the world are currently facing official demands to raise performance standards, narrow pupil performance gaps in reading and mathematics, and to provide challenges for the gifted at the same time (Deppeler and Ainscow 2016). To initiate and implement the reforms that allow schools to meet such demands also requires that teachers develop the capacity to change their teaching and learning practices. This capacity encompasses all conditions at the school and teacher level that enhance educators' professional learning and promote advances in teaching (Hopkins et al. 2011; Thoonen et al. 2012). Strategies for school improvement often rely on the assumption that teachers are able and willing to change and that both teachers and schools have the capacity to transform. However, research confirming this capacity is limited, especially in primary education. More accurately, extant literature on school improvement has not sufficiently explored how schools enhance their educational quality or realize sustainable, long-term change (Hopkins et al. 2014; Staman et al. 2014; Valenzuela et al. 2016).

Modern projects aimed at educational improvement tend to focus on data and their influence in determining student performance and teacher learning, along with the schools' ability to initiate local reforms and the success of these improvement efforts (Datnow and Hubbard 2015). Data alone, however, cannot provide all the information that educators need. Educators must analyze and interpret them in order to formulate answers to urgent questions about educational quality and student outcomes (e.g., Earl and Katz 2006; Van Geel et al. 2016). So-called inquiry-based working arguably generates school improvements (Datnow and Hubbard 2015). Nonetheless, no prior research has established a relationship between teachers' inquiry-based working on the one hand, and the capacity to change on the other–even though both constructs relate to school improvement and effectiveness (Hopkins et al. 2011).

To add to the knowledge in the area of school improvement, this study investigates whether an inquiry-based disposition enhances teacher's capacity to reform and which aspects of inquiry-based working can be assumed as the most important drivers of a teacher's capacity to change. For this purpose, we chose a quantitative approach (a quantitative survey involving 787 teachers from 65 primary schools) because we were interested in exploring these general patterns and relationships, recognizing that such an approach does not allow for an in-depth exploration. Such an exploration will be the next step if meaningful patterns are found. Accordingly, in this article, we first define and explain teacher's capacity to change and inquiry-based working. We also describe how the relationship between these two factors is understood within the literature. Secondly, we describe the context of our study, as well as the variable measurement and our multilevel analysis approach. Following the results, the most important findings and conclusions are presented and discussed in the final paragraph.

Theoretical framework

Inquiry-based working

Global shifts in the educational environment have prompted schools to consider a new approach to learning: non-routine, rather than routine, through data use (Katz and Dack 2014; Seashore Louis and Lee 2016). In inquiry-based working, teachers and teams systematically collect and analyze various types of data in an effort to improve the performance of both students and schools (Marsh and Farrell 2015). The current study adopts a holistic perspective on inquiry-based working, in line with Earl and Katz (2006) and Uiterwijk-Luijk et al. (2017). According to this view, inquiry-based working entails working with an inquiry habit of mind, demonstrating data literacy, using data at the school level, and using data in classrooms with the goal of improving educational quality. When teachers work in an inquiry-based way, they use all the data available to enhance student outcomes (Earl and Fullan 2003; Krüger 2010a; Uiterwijk-Luijk et al. 2017).

Different types of data are relevant: quantitative (e.g., test results), qualitative (e.g., interviews, observation reports), input (e.g., education level, age, children's school entry), process (e.g., observational data on school improvements), satisfaction (e.g., stakeholder satisfaction surveys), and output (e.g., student outcomes). The internal data available offer insights into effective teaching and learning strategies and results. They support accountability, but even more pertinently, they highlight the need to focus on development (Brown and Greany 2018; Earl and Fullan 2003; Earl and Katz 2006; Krüger 2010a). In inquiry-based working, evidence-based information also provides insights: Teachers and school leaders rely on external research to learn about successful strategies for realizing educational improvements. Thus, inquiry-based working relies on the use of data from a variety of sources.

To work with data in ways that enable teachers to learn, teachers investigate their own practices. Therefore, data use is assumed to improve teachers' learning and development with regard to their own educational practices, such as by improving or adapting their methods of instruction to better reflect students' educational needs (Deppeler and Ainscow 2016). In addition, as they do so collectively, the process of improving and adapting may more strongly result in meeting students' needs (Ainscow et al. 2016). According to Uiterwijk-Luijk et al. (2017), to work in an inquiry-based way, teachers must first develop an inquiry habit of mind, implying that they are curious, ask questions, and are open to engaging in deep learning. They are able to switch perspectives and discard existing routines to create new ones. Moreover, a well-developed inquiry habit of mind strengthens a teacher's sense of self-efficacy (Uiterwijk-Luijk et al. 2017).

In addition, teachers must be able to obtain meaningful information and learn from data, such that they demonstrate data literacy, or an "ability to understand and use data effectively to inform decisions" (Mandinach and Gummer 2013, p. 30). Teachers who demonstrate data literacy think about the purpose of data, understand different data types and qualities, competently interpret data, and

report their findings to others. They are capable of transforming data into information and then information into actionable knowledge. To do so, they need to be able to identify, collect, organize, analyze, summarize, and prioritize data. However, within this focus upon teachers' personal data interpretation and learning processes, both teachers and school leaders must also be able to acknowledge the existing potential for bias (Katz and Dack 2014).

Consequently, teachers who adopt an inquiry-based approach use data within their classrooms to inform them of ways to adapt their instruction and learning to correspond to students' needs. Finally, such teachers also use data at the school level when considering how to enhance educational quality.

As they use these data, teachers collectively learn. They concentrate on developing higher-quality teaching methods by employing, adjusting, and adapting standards (Ainscow et al. 2016; Seashore Louis and Lee 2016). This approach results in new insights, which then leads to new explicit knowledge at the school level. The outcomes include enhanced teaching and learning by teachers, sharper educational goals, and a stronger sense of ownership of the developments by the instructors. As deep learning takes place, reform and sustainable change occur for both individual teachers and the team as a whole (Camburn and Han 2016; Katz and Dack 2014). School cultures in which data use, an inquiry habit of mind, and data literacy are common can foster educational improvement and teacher professionalization (Krüger and Geijsel 2011; Schildkamp et al. 2012). However, educational improvement requires a teacher's capacity to change to be at a particular level.

Capacity to change

Change is a process by which an old or problematic issue is adjusted and transformed, resulting in a new experience or learning (Fullan 2016; Stoll 2009). Within this study, change refers to a planned, systematic, purposeful, and coordinated modification, aimed at achieving educational improvements within schools (Deppeler and Ainscow 2016). The capacity of teachers to change is defined as their capability to collaborate in developing and implementing innovations initiated by the government, the school board or the teachers themselves. The term also refers to teachers' ability to connect innovations to both the individual and collective learning processes that lead to change (Geijsel et al. 1999; Harris et al. 2015).

Based on Ho and Lee (2016), Thoonen et al. (2011), Diseth et al. (2012), and Geijsel et al. (2009), this study operationalizes teacher's change capacity in terms of three aspects that are all assumed to contribute to teacher's capacity to change: (1) teacher collaboration, (2) the extent to which teachers undertake professional learning activities; and (3) motivational variables, such as whether they internalize school goals as personal objectives, their sense of self-efficacy, and their job satisfaction.

Firstly, change requires collective acts, which means devoting time, effort, and energy to a learning process in order to attain certain outcomes or goals (Philpott and Oates 2017). These joint actions require collaboration because support from and communication with colleagues is necessary to realize successful change (Hargreaves and Fullan 2012; Ho and Lee 2016; Mayotte et al. 2013). In line with Little

(1982), teacher's capacity to change in terms of collaboration is meant as joint work. In joint work, teachers collectively find answers to educational and instructional problems and issues by sharing ideas and practices in order to develop innovative teaching methods (Meirink et al. 2010). There are several forms of collaboration–story telling, aid and assistance, sharing and joint work—with varying levels of task interdependency. At a high level of task interdependency, the task performance of one teacher is strongly dependent on the task performance of the others, which is the case in joint work. High levels of task interdependency between teachers are likely to encourage their learning through collaboration (Little 1982, 1990; Meirink et al. 2010). Finally, collaboration is enhanced by collegial support and trust, meaning that teachers share the belief that change should be a collective endeavor (Coburn and Turner 2011; Pogodzinski 2014; Thoonen et al. 2011). Accordingly, this study focuses on teacher collaboration as joint work that features a high level of task interdependency and collegial support.

Secondly, teacher's capacity to change can be ascertained with reference to the undertaking of professional learning activities. As demonstrated by Borman et al.'s (2003) meta-analysis, teachers who emphasize continuous development seem to exhibit an increased capacity to change. In addition, to create a climate supporting change-oriented behavior, a learning environment is imperative (Weiner and Higgins 2017). Thus, the way teachers undertake professional learning activities reflects their use of opportunities for active learning, as well as how they experiment with or reflect upon their own work and classroom teaching (Geijsel et al. 2009; Thoonen et al. 2011). Louws et al. (2016) identify that teachers are often willing to learn about curriculum and instruction-related aspects, which are topics central to being a teacher. Consequently, when a change relates to these topics, teachers are more likely to be willing to participate. Similarly, professional learning activities that lead to change also tend to be characterized by the dissemination and adaptation of insights and experiences (Camburn and Han 2016; Hargreaves and Fullan 2012; Mayotte et al. 2013). Hence, this study focuses on the extent to which teachers remain up-to-date, experiment, reflect, and share their knowledge and experiences within the team.

Thirdly, within teacher's capacity to change the concern of motivational factors needs to be considered, as personal goals and beliefs about capacities are foundational to the motivational processes that lead to commitment and change (e.g., Geijsel et al. 1999; Geijsel et al. 2009; Thoonen et al. 2011). Teachers seem more committed to their schools and more motivated to participate in learning processes when they have internalized the school's goals as their own (Geijsel et al. 2009). As such, attaining these personal goals encourages commitment and thus enhances teachers' contributions to change processes. Furthermore, without some particular level of self-efficacy, teachers are less inclined to contribute to change (Thoonen et al. 2011; Valenzuela et al. 2016). Teachers with stronger efficacy beliefs tend to persevere in their teaching beliefs and behaviors, even when confronted with difficulties. Such educators feel adequately equipped, experience less uncertainty, and find constructive answers more quickly (Oude Groote Beverborg et al. 2015). Committed and satisfied teachers play a vital role in helping their schools develop successfully; their higher levels of organizational commitment and job satisfaction encourage

them to devote more efforts to attaining organizational goals. Job satisfaction here is meant as the result of a relaxed and positive emotional state attained within experiences within one's job (Hulpia et al. 2009). However, job satisfaction is a complex variable, influenced by both the dispositional characteristics of the employee and the situational factors of the job (Singh and Kaur 2010). Teachers who are satisfied with their jobs are likely to demonstrate greater dedication to the organization and are willing to contribute to, and accept, change. Motivational variables–such as self-efficacy, job satisfaction, and the ability to embrace school goals as personal targets–keep teachers abreast of current trends in education and increase their willingness to apply those advances to their own teaching practices (Hulpia et al. 2009; Thoonen et al. 2012).

To develop a capacity for change, teaching skills are critical. Skills develop over time, and experienced teachers may be more capable of changing their mindsets by drawing on other perspectives (Desimone 2009). Additionally, in the Dutch educational context, teachers at graduate school level, wherein teachers develop an inquiry habit of mind and endorse the relevance of inquiry-based working, are increasingly desired. Accordingly, background characteristics–such as the amount of teaching experience and teacher's level of education–seemingly influence the extent to which teachers work in an inquiry-based way (e.g., Kocór and Worek 2017; Mueller 2013; Mullola et al. 2011; Rubie-Davies et al. 2012).

To investigate the extent to which teachers' inquiry-based working explains differences in the capacity to change, the current study centered on primary schools in the Netherlands. The aim was to determine whether an inquiry-based disposition enhances teachers' capacity to transform, with the ultimate goal of improving educational quality. Accordingly, the central research questions were as follows:

1. To what extent does teachers' inquiry-based working in primary schools predict their capacity to change?
2. Which aspects of inquiry-based working are the most important drivers of teachers' capacity to change within primary schools?

Figure 1 illustrates the key concepts and how they, in line with the research questions, are assumed to be related.

Method

Context, participants, and procedures

In the Netherlands, children aged 4 to 12 years participate in eight years of primary education. Education is compulsory from the age of five years. In the last year of primary education, students receive a recommendation for appropriate secondary schooling. These suggestions are partly based on the results of a national test, though parental and teacher preferences also play a role. Most Dutch primary schools are government-funded private institutions, and many have a religious

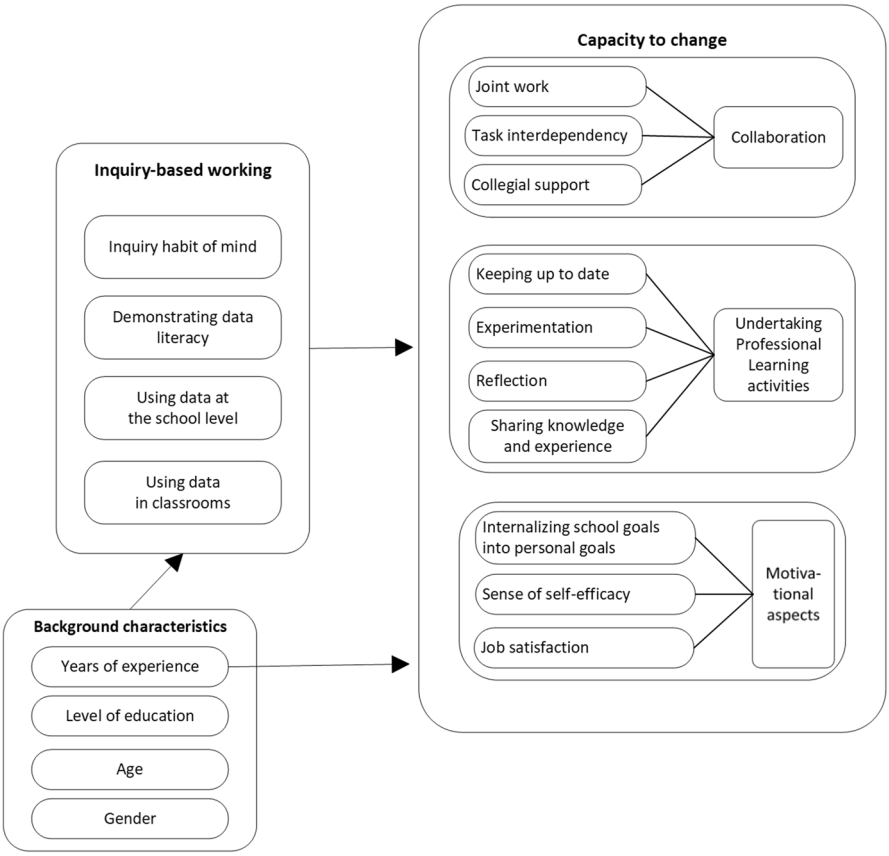

Fig. 1 The key concepts and the relationships assumed

affiliation. Although the Netherlands does not have a national curriculum, there is a national standardized framework with indicators included. Schools are autonomous, which means that they have the *right of self-government–encompassing the freedom to make independent decisions–on the responsibilities that have been decentralized to schools* (Neeleman 2018, p. 4). This autonomy is reflected in school's policies related to pedagogical approaches, personnel, and financial management. Quality standards apply to all schools, however, and the national inspectorate is tasked with ensuring educational quality. A risk-based approach is followed, wherein control of output is central (Ehren et al. 2017). Based upon the Dutch context of an applied quality standard to all schools and the absence of a national curriculum, a teacher's capacity to change is relatively important. To serve the different educational needs of their students, teachers should be able to initiate and adapt educational and instructional improvement and, simultaneously, comply with the quality standards.

Almost 500 schools were invited by post and e-mail to participate in this study. A total of 65 schools took part, most of them located in the mid-western or eastern regions of the Netherlands. A web-based survey was sent to 1209 teachers, all working with students between the ages of 4 and 12 years, including students with special educational needs. The questionnaire was completed by 963 teachers from April to June, 2016, representing a response rate of 79%. For 176 participants, more than 10% of the data were missing; these incomplete response sets were excluded from the analysis. A sample of 787 teachers was, therefore, generated. The sample's gender ratio (89.4% female, 10.6% male) reflected that of the larger population of Dutch primary school teachers (87% female, 13% male; see www.statline.nl).

The demographic characteristics of the participants are summarized in Table 1. A few respondents (32%) were younger than 35 years. The grade distribution was fairly equal, and almost 70% of the teachers had bachelor's degrees. Team sizes ranged between 4 and 38 teachers, and the participation rate of the teams varied between 31% and 100%.

Table 1 Participants' demographic characteristics (N = 787)

Demographic characteristic		*n*	%
Gender	Female	703	89
	Male	84	11
Age at time of survey	< 25	33	4.2
	25–34	215	27.4
	35–44	209	26.6
	45–54	157	19.9
	> 55	170	21.6
Years of experience in primary education	< 4	77	9.8
	5–9	158	20.1
	10–14	168	21.3
	>15	383	48.7
Class level taught	Grade 1 and 2	181	23
	Grade 3	90	11.4
	Grade 4	91	11.6
	Grade 5	76	9.7
	Grade 6	76	9.7
	Grade 7	77	9.8
	Grade 8	86	10.9
	Other function (e.g., special educational needs)	107	13.6
Educational level	No bachelor's or master's degree	34	4.3
	Bachelor's degree	549	69.8
	Master's degree	201	25.6

Variable measures

To measure primary school teachers' inquiry-based working and capacity to change, the authors developed a new questionnaire with items drawn from or based on existing scales (Geijsel et al. 2001; Krüger 2010b; Oude Groote Beverborg et al. 2015; Schildkamp et al. 2012). Certain items were self-formulated. All items pertaining to inquiry-based working and the capacity to change used 5-point Likert scales, ranging from 1 (totally disagree) to 5 (totally agree). To test for construct validity, the questionnaire was piloted with 10 primary school teachers working in grades 1 to 8 who were not otherwise involved in this research. The feedback from the pilot test was incorporated into the final questionnaire.

Inquiry-based working

The inquiry-based working questionnaire contained 22 items across four scales: working with an inquiry habit of mind (5 items, e.g., "Out of curiosity, I systematically ask questions in my work," Cronbach's alpha = .82), demonstrating data literacy (7 items, e.g., "I am able to process and analyze collected data," Cronbach's alpha = .89), using data at the school level with the aim of improving educational quality (6 items, e.g., "To us, it is essential to analyze data on how to enhance educational quality," Cronbach's alpha = .82), and using data in classrooms (4 items, e.g., "In preparing my lessons, I use data on my students," Cronbach's alpha = .81).

Capacity to change

The capacity to change was investigated and assessed by means of multi-item scales (total of 56 items), measuring (1) teachers' collaborations, (2) the ways teachers undertook professional learning activities, and (3) three motivational variables (i.e., the extent to which teachers internalized school goals, the teachers' sense of self-efficacy, and job satisfaction).

To measure collaboration, three scales addressed joint work (6 items, e.g., "In our team, we evaluate new approaches," Cronbach's alpha = .84), task interdependency (4 items, e.g., "In our team, we need information from each other to do our jobs," Cronbach's alpha = .72), and collegial support (6 items, e.g., "My colleagues tell me about the difficulties they face in teaching and how they solve them," Cronbach's alpha = .85).

The extent to which the teachers undertook professional learning activities was measured with four scales. The first addressed the degree to which the teachers kept themselves up-to-date in the field of teaching (6 items, e.g., "I undertake initiatives on my own to ensure my own professional development," Cronbach's alpha = .86). Subsequently, the extent to which the teachers experimented (4 items, e.g., "In my lessons, I test new instructional approaches," Cronbach's alpha = .74) and reflected (5 items, e.g., "I compare my current teaching to my teaching from one year ago,"

Cronbach's alpha = .80) were assessed, as was the degree to which the teachers shared their knowledge and experience (6 items, e.g., "In our team, teachers share opinions and ideas about educational developments," Cronbach's alpha = .89).

Four items measured the extent to which teachers internalized school goals and generated them into personal targets (e.g., "I completely endorse our school goals and my actions support them," Cronbach's alpha = .80). Both a sense of self-efficacy (e.g., "I feel like I am successful in my work," Cronbach's alpha = .81) and job satisfaction (e.g., "I am satisfied with my job as a teacher," Cronbach's alpha = .88) were measured with 5 items each.

Background characteristics

The survey included items to measure five background traits. Gender was binary (1 = female, 2 = male). Respondents could choose from five age categories (coded 1–5): < 25 years, 25–34 years, 35–44 years, 45–54 years, or ≥ 55 years. The years of experience variable featured four levels: 1 = less than 4 years, 2 = 4–10 years, 3 = 10–15 years, and 4 = 15 years or more. For the educational level of the participants, 1 = no bachelor's or master's degree, 2 = bachelor's degree, and 3 = master's degree. Finally, the class level taught (grades 1–8) took the respective grade as a value, and then the option "other function (special educational needs)" was coded 9.

Data analysis

Multilevel methods were used to analyze the data. Intra-class coefficients computed for the intercept-only models illustrate the effect of clustering on the ten variables reflecting the different aspects of a teacher's capacity to change; the values range from .03 to .32. Subsequently, to assess the extent to which all four inquiry-based variables explain within-school differences in the capacity to change, multilevel analyses were performed (procedure Mixed, SPSS version 23, SPSS Inc., 2016). For each dependent variable (collaboration, undertaken learning activities, and motivational variables), the analysis calculated the difference between a model containing all four inquiry-based working variables and an empty (intercept-only) model.

The independent variables were group mean-centered because the analysis was not focused on the school level but rather on teachers' perceptions (Tabacknick and Fidell 2013). With regard to the amount of within-school variance explained by the multilevel models, the factor of interest was the reduction in the variance within the random intercept parameters due to the inclusion of different aspects of inquiry-based working, or their combinations. Demographic characteristics served as covariates. The full model, including the four aspects of inquiry-based working and the demographic characteristics, offered a significantly better fit than one that only integrated the intercepts (see Table 2). Across the participants, the slopes did not vary. For each dependent variable, the final model differed significantly from the full model, as illustrated in Table 2. All four predictors of inquiry-based working improved the fit of the model in terms of each aspect of the capacity to change.

Table 2 Comparison of multilevel models predicting the capacity to change on the basis of inquiry-based working

		Null model M1	Full model M2		Final model M3	
		−2 log likelihood	−2 log likelihood	χ^2 difference test (M1–M2)	−2 log likelihood (df)	χ^2 difference test (M2–M3)
Collaboration	Joint work	1681.666	1558.024	123.642*	1544.275 (10)	13.749*
	Task interdependency	1392.334	1257.228	135.106*	1239.233 (9)	17.995*
	Collegial support	1633.292	1514.190	119.102*	1502.803 (10)	11.387*
Professional learning activities undertaken	Keeping up to date	1599.868	1164.432	435.436*	1143.395 (9)	21.037*
	Experimenting	1502.370	1274.890	227.480*	1257.773 (9)	17.117*
	Reflecting	1231.511	797.335	434.176*	771.204 (9)	26.131*
	Sharing knowledge and experience	1684.678	1503.729	180.949*	1487.047 (10)	16.682*
Motivational variables	Internalizing school goals into personal goals	1369.280	1061.133	308.147*	1038.421 (9)	22.712*
	Sense of self-efficacy	1372.718	1113.230	259.488*	1091.920 (8)	21.310*
	Job satisfaction	1538.595	1444.133	94.462*	1431.061 (10)	13.072*

M1 df = 3, M2 df = 13, *$p < .01$

The demographic predictors also improved the model's fit, and each contributed uniquely to each dependent variable to establish the best possible fit.

Results

Descriptive statistics

For the four aspects of inquiry-based working, the mean item scores varied between 4.17 and 4.59. The mean scores for the capacity to change aspects spanned from 3.81 to 4.47. The midpoint on the 5-point Likert scales is 3.0, so these results indicated positive, relatively high scores for all variables, as detailed in Table 3. The distribution measures revealed a moderately negative skewness for two inquiry-based working aspects; namely, data literacy and classroom data use. For the latter, a high positive kurtosis also emerged. However, skewness and kurtosis do not make a substantive difference in an analysis with a sample that is greater than 200 respondents (Tabacknick and Fidell 2013).

Multilevel analysis

The next step was to examine the extent to which teachers' inquiry-based working explained differences in the capacity to change, and then determine which aspects of inquiry-based working were most critical for enhancing primary school teachers' capacity to change. The dependent variables referred to collaboration, professional learning activities undertaken, and the three motivational factors. The independent variables pertained to the aspects of inquiry-based working: working with an inquiry habit of mind, demonstrating data literacy, using data at the school level to improve educational quality, and using data in classrooms. The analysis included both the main and interaction effects.

The correlations were moderately high ($0.5 \geq r \leq 0.7$). For one-sided testing, the results are significant if the p value is less than or equal to 0.05. In the following tables, significance levels appear in bold font. To gauge the eta-squared effect sizes, this study used Cohen's (1988) values: 0.02 = small, 0.13 = medium, and 0.26 = large effect.

Collaboration variables

Collaboration was measured using three scales: (1) joint work, (2) task interdependency, and (3) collegial support. The results in Table 4 reveal that working with an inquiry habit of mind and using data in classrooms had significant predictive power for task interdependency; data use at the school level significantly and positively predicted joint work. Moreover, working with an inquiry habit of mind predicted collegial support to a significant degree. Demonstrating data literacy, however, was not a significant predictor of any aspect of collaboration. The eta-squared values

Table 3 Descriptive results for the scales used

			N	*M*	*SD*	Skewness		Kurtosis	
							SE		*SE*
Inquiry-based working	Working with an inquiry habit of mind		787	4.17	.59	−1.03	.09	2.03	.17
	Demonstrating data literacy		787	4.51	.54	−2.15	.09	8.25	.17
	Data use at the school level		787	4.16	.63	−.88	.09	1.31	.17
	Data use in classrooms		787	4.59	.49	−2.45	.09	10.73	.17
Capacity to change	Collaboration	Joint work	787	3.84	.78	−.93	.09	.54	.17
		Task interdependency	787	4.33	.58	−1.70	.09	4.33	.17
		Collegial support	787	3.91	.71	−.80	.09	.82	.17
	Motivation	Internalizing school goals into personal goals	787	4.47	.59	−1.87	.09	5.70	.17
		Sense of self efficacy	787	4.19	.58	−1.19	.09	2.91	.17
		Job satisfaction	787	4.31	.69	−1.61	.09	3.52	.17
	Professional learning activities undertaken	Keeping up to date	787	4.20	.67	−1.08	.09	1.44	.17
		Experimenting	787	4.15	.63	−.92	.09	1.41	.17
		Reflecting	787	4.44	.53	−1.81	.09	6.79	.17
		Sharing knowledge and experience	787	3.81	.77	−.85	.09	.73	.17

1 = totally disagree, 2 = partly disagree, 3 = neither disagree nor agree, 4 = partly agree, 5 = totally agree. M = mean item scores, SD = standard deviation, SE = standard error

Table 4 Multilevel analysis: summary of inquiry-based working variables' ability to predict collaboration variables

	Intercept*	Working with an inquiry habit of mind		Demonstrating data literacy		Using data at the school level		Using data in classrooms		η^2
	b (*SE*)	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	p	
Joint work	3.88(.06)	.06(.04)	.18	− .05(.05)	.33	.13(.05)	**.01**	.07(.06)	.24	.12
Task interdependency	4.35(.03)	.25(.04)	**.00**	.01 (.05)	.79	.00(.05)	.97	.16(.06)	**.00**	.19
Collegial support	3.94(.05)	.13(.04)	**.00**	.02(.05)	.76	.01(.05)	.78	.08(.06)	.17	.13

Significant *p*-values (≤ .05) are reported in bold type

b regression coefficient, *SE* standard error, η^2 = eta squared

*All intercepts are significant ($p < .00$)

($\eta^2 = 0.12$–0.19) were all medium-sized, implying that 12%–19% of the variance in the collaboration scores could be explained by the aspects of inquiry-based working.

The interaction between working with an inquiry habit of mind and demonstrating data literacy was a significant and negative predictor of both joint work ($b = -0.20$; $SE = 0.10$; $p = 0.02$) and task interdependency ($b = -0.20$; $SE = 0.09$, $p = 0.02$). Teachers working with an inquiry habit of mind were less inclined to engage in joint work when they also demonstrated data literacy.

Professional learning activities variables

Undertaking professional learning activities involved four scales: (1) keeping up to date, (2) experimenting, (3) reflecting, and (4) sharing knowledge and experience. As displayed in Table 5, working with an inquiry habit of mind and demonstrating data literacy significantly predicted keeping up-to-date, whereas working with an inquiry habit of mind and using data in classrooms both significantly

Table 5 Multilevel analysis: summary of inquiry-based working variables' ability to predict professional learning activities variables

	Intercept*	Working with an inquiry habit of mind		Demonstrating data literacy		Using data at the school level		Using data in classrooms		η^2
	b (*SE*)	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*	
Keeping up to date	4.20 (.03)	.65 (.04)	**.00**	.15 (.05)	**.00**	.05 (.04)	.24	.06 (.05)	.30	.43
Experimenting	4.16 (.03)	.40 (.04)	**.00**	.04 (.05)	.49	− .04 (.05)	.45	.18 (.06)	**.00**	.25
Reflecting	4.46 (.02)	.35 (.03)	**.00**	.04 (.04)	.34	.04 (.03)	.28	.17 (.04)	**.00**	.44
Sharing knowledge and experience	3.86 (.05)	.13 (.04)	**.00**	− .01 (.05)	.82	.13 (.04)	**.00**	.00 (.05)	.96	.18

Significant *p*-values (≤ .05) are reported in bold type

b regression coefficient; *SE* standard error; η^2 eta squared

*All intercepts are significant ($p < .00$)

predicted experimenting and reflecting. Moreover, working with an inquiry habit of mind and using data at the school level significantly predicted sharing knowledge and experience. According to these results, working with an inquiry habit of mind was a significant and positive predictor of all aspects related to undertaking professional learning activities. The eta-squared values ($\eta^2 = 0.19–0.44$) were medium or large, such that 19%–44% of the variance in the professional learning activities scores could be explained by inquiry-based working.

A positive interaction effect emerged between working with an inquiry habit of mind and using data at the school level; together, the two variables predicted reflecting ($b = 0.17$; $SE = 0.07$, $p = 0.02$). The interaction between working with an inquiry habit of mind and using data at the school level ($b = -0.18$; $SE = 0.08$, $p = 0.03$) significantly and negatively predicted sharing knowledge and experience. Teachers using data at the school level were more willing to reflect when they also had an inquiry habit of mind. However, those educators were also less inclined to share their knowledge and experience.

Motivational variables

The motivational variables, related to the capacity to change, involve the extent to which teachers internalize school goals, their sense of self-efficacy, and their job satisfaction. Table 6 illustrates the ability of the inquiry-based working variables to predict these motivational variables. Working with an inquiry habit of mind, using data at the school level, and using data in classrooms were significant, positive predictors of internalizing school goals as personal aims. A teacher's sense of self-efficacy was significantly, positively predicted by working with an inquiry habit of mind, demonstrating data literacy, and using data in classrooms. The eta-squared values ($\eta^2 = 0.11–0.32$) were medium or large, so 11%–32% of the variance in the motivational variable scores was explained by inquiry-based working. However, none of the four aspects of inquiry-based working was a significant predictor of job satisfaction. Moreover, no interaction effects emerged between the aspects of inquiry-based working and the motivational variables.

A teacher's level of education provided a significantly positive predictor of keeping up to date ($b = 0.058$, $SE = 0.02$, $p = 0.009$). Teachers with a master's degree were more willing to keep abreast of new knowledge and educational developments than were instructors without one. The teacher's education level was also a significant, negative predictor of joint work ($b = -0.006$, $SE = 0.02$, $p = 0.001$), collegial support ($b = -0.098$, $SE = 0.03$, $p = 0.001$), sharing knowledge and experience ($b = -0.14$, $SE = 0.03$, $p < 0.001$), internalizing school goals ($b = -0.06$, $SE = 0.02$, $p = 0.01$), and job satisfaction ($b = -0.07$, $SE = 0.03$, $p = 0.007$). That is, teachers who had attained a master's degree were less inclined to exhibit these aspects of a capacity to change.

As the results in Table 7 demonstrate, the model was capable of explaining within-school differences among teachers. Regarding aspects of the capacity

Table 6 Multilevel analysis: summary of inquiry-based working variables' ability to predict motivational variables

	Intercept*	Working with an inquiry habit of mind		Demonstrating data literacy		Using data at the school level		Using data in classrooms		η^2
	b (*SE*)	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*	*b* (*SE*)	*p*	
Internalizing school goals into personal goals	4.52 (.03)	.20 (.03)	**.00**	.04 (.04)	.39	.10 (.04)	**.01**	.14 (.05)	**.00**	.32
Sense of self-efficacy	4.22 (.03)	.16 (.04)	**.00**	.19 (.04)	**.00**	.03 (.04)	.49	.13 (.05)	**.01**	.30
Job satisfaction	4.36 (.05)	−.00 (.04)	.95	−.03 (.05)	.48	−.05 (.04)	.23	.05 (.05)	.31	.11

Significant *p*-values (≤ .05) are reported in bold type

b regression coefficient, *SE* standard error, η^2 eta squared

*All intercepts are significant ($p < .01$)

Table 7 Variance in capacity to change explained by inquiry-based working within schools

		R^2 within schools
Collaboration	Joint work	.18
	Task interdependency	.20
	Collegial support	.18
Professional learning activities undertaken	Keeping up to date	.47
	Experimenting	.27
	Reflecting	.48
	Sharing knowledge and experience	.26
Motivational variables	Internalizing school goals into personal goals	.38
	Sense of self-efficacy	.33
	Job satisfaction	.15

to change, 18%–48% of the within-school variance could be explained by the inquiry-based working variables.

Discussion

This study sought to investigate how and to what extent teachers' inquiry-based working predicts their capacity to contribute to change. The answers to these questions can help different stakeholders to develop strategies for initiating school reforms and improving the change capacity of teachers. The teachers' change capacity was operationalized in terms of three aspects: (1) teachers' collaborations, (2) the extent to which teachers undertake professional learning activities, and (3) motivational variables. Each aspect was divided into several sub-aspects.

Regarding our first research question, '*To what extent does teachers' inquiry-based working in primary schools predict their capacity to change?*', we found that all the inquiry-based working variables—working with an inquiry habit of mind, demonstrating data literacy, data use at the school level, and data use in classrooms—were significant drivers, promoting an increased capacity to change among teachers. Together they have a relatively great impact on teacher's change capacity. Thus, inquiry-based working is of great importance with respect to reinforcing the capacity to change within primary schools. Hence, schools can focus on enhancing the inquiry habit of mind and data literacy of their teachers, along with their use of data in classrooms and at the school level. If teachers work in such a way, they are likely to collaborate, learn, have a high sense of self-efficacy, and feel motivated to try to accomplish the school's goals. Whereas Seashore Louis and Lee (2016) in their research suggested that in a culture in which data use is a common and shared activity teacher professionalization emerges, in our study, we adopted data use related to inquiry-based working, which is a much broader approach. In this approach, besides having skills to work with data, an inquiry-based attitude

is essential. Such an attitude is reflected in working with an inquiry habit of mind which means that these teachers are curious, ask questions, and base their rational judgements on facts, use data in order to learn and adapt new instructional practices. Consequently, an inquiry habit of mind together with data use stimulates teachers to reflect upon and learn from data, and, therefore, offer guidance for classroom practices. Against this background, change is not something that happens to teachers. On the contrary, teachers can initiate change and adapt their instructional strategies, based on facts and knowledge. Thus, it is worthwhile to encourage schools and teams to collectively work in an inquiry-based way as this may reinforce teachers´ capacity to change, which can lead to an enhanced educational quality and strengthened opportunities to meet students' needs.

In the current study, the participants scored relatively high on almost all scales for inquiry-based working and the capacity to change, which may have been caused by the fact that schools that have already adopted an inquiry-based approach may have been more interested in participating in this study than other schools would have been. However, as the purpose of this study was to relate teachers' inquiry-based working to their capacity to change, this might be called an advantage: we needed such schools to investigate this relationship.

With regard to our second research question, '*Which aspects of inquiry-based working are the most important drivers of a teacher's capacity to change in primary schools?*', we found that working with an inquiry habit of mind appeared to be the most important driver in reinforcing teachers' capacity to change. Teachers who work with an inquiry habit of mind like to collaborate with colleagues, exhibit a high level of professional learning, internalize school goals into personal aims, and have a high sense of self-efficacy. Whereas Brown and Greany (2018) displayed that school leaders should stimulate and support teachers' abilities to work with data, our findings showed that data literacy has very little influence on their capacity to change; it only leads to keeping up-to-date and self-efficacy. Our study reveals that working with an inquiry-habit of mind is of much more importance than teachers being data literate. With this finding, we add on research of Krüger (2010a). She states that though it is not necessary for all teachers to conduct research themselves or to be data literate, they must work with an inquiry habit of mind. Therefore, school leaders could stimulate their teachers to utilize their curiosity and retain an open mind to new perspectives, for such an attitude appeals to their inquiry habit of mind.

We also found data use at the school and classroom levels to be key aspects of inquiry-based working. Teachers who frequently use data at the classroom level may express a higher sense of task interdependency, tend to learn through experimentation and reflection and to internalize school goals. Moreover, their sense of self-efficacy seems to increase. In particular, using data in the classroom is crucial for the realization of evidence-based improvements in teaching strategies. Using data at the school level enhances the capacity to change as well. It appears to reinforce the likelihood of teachers to internalize school goals as well as their tendency to share their knowledge and experience and work jointly. Whereas the literature indicates that collaboration is essential in realizing change (e.g., Hargreaves and Fullan 2012; Harris et al. 2015; Ho and Lee 2016, our findings disclose that both individuality and collectivity are needed to foster a capacity to change. In a sense, data use at the

school level and at the classroom level seem to be complementary factors that supplement each other's ability to affect a capacity to change. Their complementarity is understandable, in that data use at the school level influences teamwork, while data use in the classroom, experimentation, reflection, a sense of self-efficacy, and the internalization of school goals into personal goals are all based on individual teacher actions (Earl and Katz 2006).

In contrast with our supposition, teacher's job satisfaction was not predicted by any aspect of inquiry-based working. An explanation for this may be found in the fact that job satisfaction is a complex variable, influenced by both the dispositional characteristics of the individual and the situational factors of the job (Singh and Kaur 2010). However, in the current study, the measurement of job satisfaction did not integrate situational factors. Therefore, caution is required with respect to this finding.

Supplementary to our research questions, we found some interaction effects. First, working with an inquiry habit of mind and demonstrating data literacy negatively interacted with joint work and task interdependency. It appears that teachers who work with an inquiry habit of mind and who also demonstrate data literacy, are less inclined to engage in joint work featuring interdependent tasks. We identified that working with an inquiry habit of mind, teacher's capability to reflect, self-efficacy, and the extent to which teachers internalize school goals into personal goals relate to the characteristics of individual teachers. In contrast, joint work and task interdependency require shared capabilities. Furthermore, the results from the current study reflect the teachers' own perceptions, which can be called a limitation. (Schwartz 1999). It is also important to emphasize that the methods used in this study were not intended to find causal relationships. This means caution is advised regarding the findings and the interpretations.

As a second negative interaction effect, it seems that teachers with an inquiry habit of mind, who use data at the school level, do not tend to share knowledge and experiences with others. However, teachers working with an inquiry habit of mind appear to be more reflective upon their own actions and behavior when they also use data at the school level. It may be the case that teachers working with an inquiry habit of mind and demonstrating data literacy believe that they are able to interpret the data they collect and that they can give feedback to themselves. In this way, these educators may feel autonomous. Autonomy is a facet of an internal condition, and, as such, it relates to the motivational variables (Little 1990). For teachers with a strong sense of autonomy, this trait may lead to stand-alone behavior rather than collaboration. These teachers may believe that they do not need feedback from their colleagues to verify their way of working. On the other hand, considering the positive interaction between teacher's inquiry habit of mind, data use, and teacher's reflectivity, it seems that when a teacher's reflective process is based on curiosity and data, their reflection may even more strongly alter their mindsets by drawing on other perspectives, which is in line with the findings of Desimone (2009). School leaders could use this positive interaction by providing teachers with challenging tasks. Such challenging and innovative work requires reflectivity and may enhance teacher's capacity to change even further.

With respect to the background characteristics—gender, age, teacher's level of education and experience—we found that education level seemed to offer positive predictors of a teacher's willingness to stay abreast of developments in the field. As such, it appears to be relevant to stimulate teachers to obtain a higher education level, for instance a masters' degree, for more education generally increases teacher's professional capital (Kocór and Worek 2017). All other background characteristics did not relate significantly to any of the aspects of inquiry-based working. This finding conflicts with findings by Mullola et al. (2011), Rubie-Davies et al. (2012), and Mueller (2013). They found that these characteristics might influence teachers' inquiry-based working. Our findings, on the other hand, support the findings of Uiterwijk-Luijk et al. (2017) that age and gender have no significant relationship to any aspect of teacher's inquiry-based working.

Implications for educational practice and policy

Because of the ongoing theme of raising performance standards, teachers need capacity to change in order to adapt their teaching and learning practices. Our study reveals that inquiry-based working strongly predicts teachers' capacity to change and that working with an inquiry habit of mind is the strongest driver along with data use at the school and classroom level. However, we performed our study in the field of Dutch primary education. In the Netherlands schools are autonomous, although the accountability and output control are still leading (Ehren et al. 2017; Neeleman 2018). Dutch schools differ from schools in other countries in the extent of their autonomy. Therefore, when describing the implications for educational practice and policy, we distinguish between implications for the Netherlands and for other countries.

First, in the Dutch system, our framework of inquiry-based working and teachers' capacity to change is useful for both school leaders and teachers and for educators of leaders and teachers. Stimulating teachers to work inquiry-based, teaching them how to adopt an inquiry habit of mind, and collectively using data at the classroom and school level may reinforce teachers' capacity to change. In this way, teachers may change their teaching strategies in order to meet their students' educational needs. As such, schools can deliberately exploit and benefit from the autonomy offered, and vice versa, such a schools' autonomy enables schools to work inquiry-based. Meanwhile, the Dutch governmental approach is still based on output control and ranking, which may lead to competition between schools and, for instance, teaching to the test (Hadfield and Ainscow 2018). Based on our framework and results, we suggest that along with the output control the national inspectorate will also utilize contextual methods of evaluations. As such, teachers can use their ability to prioritize and make choices in their own contextual practices, whereas their decisions in the adjustments of teaching and learning strategies are based on facts and knowledge.

Second, although the autonomy in Dutch schools differs from the educational systems in many other countries all over the world, the findings might be useful for schools, governments and policy makers in other countries, because our study

shows that in a system of schools' autonomy teams focus on educational development by means of inquiry-based working. Therefore, without abandoning the accountability approach, governments and policy makers worldwide could consider granting schools a certain extent of autonomy. Since schools are operating in different regions, cities and contexts, schools are confronted with different demands of students' needs. A certain degree of autonomy may appeal to teachers' creativity and offers them opportunities to adapt their teaching and learning strategies to their specific context. In such a context of schools' autonomy, teachers may feel capable of moving forward and meeting the demands of adjusting their teaching practices to serve the different needs of their students. Inquiry-based working could stimulate teachers to collaborate and might enhance their sense of self-efficacy.

Data use for both educational development and accountability requires courage from teachers and school leaders. Therefore, we underpin the importance of trust from the government in school's capabilities to realize educational growth and development. In line with Fink's (2016) statements about trust, we emphasize that confidence of the government and the inspectorate in schools and trust within schools might be a key factor in realizing educational changes through an inquiry-based way of working. Trust may contribute to teachers' and school leaders' courage.

In our study, accountability and schools' autonomy seem to be relevant variables. By adding these variables to our framework, future research might give more insight in differences between countries according the relationship between inquiry-based working and teacher's capacity to change. Besides, our quantitative approach did not provide detailed insights into how teachers practice and experience inquiry-based working. It would be useful to identify how teachers give meaning to inquiry-based working and to the relationship between inquiry-based working and the realization of educational changes. Therefore, the next step should be to explore these patterns in a more qualitative way.

Conclusions

This study enriches our understanding of inquiry-based working and how teacher's change capacity links in with conditions in this way of working. From a theoretical perspective, our findings offer new insights in how inquiry-based working is related to the capacity to change of primary school teachers. Valuable conclusions can be drawn about the reinforcement of teacher's capacity to change, which we operationalized in terms of collaboration, professional learning activities, and motivational variables. First, inquiry-based working strongly appears to predict teacher's capacity to change, which means that these teachers seem to be likely to collaborate, initiate their own professionalization, have a high sense of self-efficacy, and feel motivated to contribute to achieve the school's goals.

Second, herein, the most important driver seems to be working with an inquiry habit of mind. A strong inquiry habit of mind might serve teacher's inclination to collaborate and obtain a high level of professional learning. Also, such a habit may contribute to teacher's sense of self-efficacy and their internalization of school goals into personal goals. In addition, as we found data use at the school level and

in classrooms to be complementary, data use at these two levels also is an important driver. Both individuality and collectivity are valuable in fostering teacher's capacity to change. A higher teacher's education level such as a master's degree seems to offer positive predictors of a teacher's willingness to stay abreast of educational developments. Finally, as working with an inquiry habit of mind and data literacy may interact with joint work and sharing knowledge and experiences, school leaders could encourage and support collaborative inquiry. Also, they could promote a positive attitude towards inquiry-based working and emphasize its benefits for the educational quality at classroom and school level, as well as for teachers' well-being. Ultimately, a school team that works in an inquiry-based way is able to make its own substantiated educational choices in order to meet the different needs of their students.

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